BACKGROUND OF THE INVENTION

The present invention relates to a novel [[new]] method for [[of]] rendering a fabric elastic, a machine for implementing the method, and the fabric obtained by the method.

More particularly, ~~the applicant has found~~ a solution has been found to a problem not yet solved; ~~consisting in~~ giving a characteristic of elasticity to a fabric produced with fibers that are naturally non-elastic [[,]] ~~that is to say~~ before treatment.

SUMMARY OF THE INVENTION

This solution involves a method for ~~consists in a~~ mechanically and chemically ~~method of~~ treating a fabric by impregnation with caustic soda, or with another metal peroxide. The method includes application of the metal peroxide [[,]] ~~characterized in that it consists in applying~~ to a hydrophilic fabric, for example a de-sized fabric and/or a previously bleached fabric [[one]], having threads oriented in a selected machine direction, including a [[whose]] weft, [[(]] or inversely, a [[whose]] warp, [[)]] which ~~consists of~~ threads are made of natural or artificial cellulose ~~fibers:~~

[[-]] ~~impregnation~~ fibers. During impregnation with the [[a]] metal peroxide, ~~leaving~~ the weft (or inversely

the warp) of the fabric is left free for a period of time necessary for [[the]] swelling of the fibers constituting the weft (or inversely the warp) of the fabric and for [[the]] modification of the cellulose forming the fibers of the fabric. The fabric is then subjected to at [[,]]

[[- at]] least one relaxation with no weft tension (or inversely, with no warp tension), by passage in air, during which the weft (or inversely the warp) swells and then assumes a [[its]] spring shape, after ~~shrinkage,~~

[[- at]] shrinkage, at least one ~~rinsing,~~

[[- at]] rinsing, at least one ~~washing,~~

[[- at]] washing, and at least one squeezing.

More particularly, and as a nonlimiting example ~~but not limitatively~~, the fabric is placed in ~~time of~~ alkaline contact at 14 to 25° Baumé for a time [[is]] less than 5 minutes.

Following ~~Preferably, it comprises, after the~~ impregnation, the treatment method of the present invention preferably includes at least a first vigorous squeezing, for example, with a driving off rate of at least 70% of the product, followed by a first relaxation passage in air, for example, for [[of]] at least one minute.

Preferably, the [[a]] fabric to be treated has a ~~is used whose~~ weft (or inversely a [[whose]] warp) comprised ~~consists~~ of cellulose-based fibers, and a ~~fabric whose~~

construction which allows [[the]] swelling of the weft (for example, by about 30% to 50%) and a strong squeezing.

Also provided is a machine for [[An]] implementing the foregoing method, which ~~machine~~ principally and successively includes an ~~comprises:~~

[[• an]] impregnation ~~station,~~

[[• at]] station, and at least a first squeezing ~~station,~~

[[• at]] station and [[least]] a first relaxation ~~station,~~

[[•]] ~~possibly~~ station. The machine can further be optionally and successively provided with a direction-changing ~~roller,~~

[[•]] ~~possibly~~ roller, a second squeezing ~~station,~~

[[•]] ~~possibly~~ station, a second relaxation ~~station,~~

[[•]] ~~possibly~~ station, a rinsing ~~station,~~

[[• one]] station, one or two washing ~~stations,~~

[[• a]] stations, a final squeezing ~~station,~~

[[• a]] station, and a rolling-up station. The machine can further include means for [[,]]

[[•]] ~~means of~~ regulating the speed of progress of the fabric through the machine, for ~~capable of~~ managing the duration of the impregnation with caustic soda and the duration of the relaxation in air.

The fabric obtained is a cellulose-based elastic fabric whose weft (or inversely whose warp) is comprised ~~consists~~ of cellulose fibers that were not naturally elastic before application of the treatment method of the present invention

and that have elastic ~~having~~ properties ~~of elasticity~~ in the weft direction (or inversely, in the warp direction) which are conferred upon the fabric [[it]] by the treatment method of the present invention. The warp (or inversely the weft) can be made of other materials, but must be able to withstand the peroxide treatment. By way of example, ~~it is possible to use~~ certain synthetic materials, such as polyester, can be used for this.

Further discussion of the present [[The]] invention is provided in ~~will be better understood with the help of~~ the description given below, with reference to the following illustrations. ~~appended figures:~~

BRIEF DESCRIPTION OF THE DRAWINGS

[[-]] Figure ~~figure~~ 1 is a schematic ~~diagrammatic~~ representation of the method of ~~according to~~ the present invention. [[,]]

[[-]] Figures ~~figures~~ 2, 3 and 4 are enlarged views of illustrative threads, based on cellulose fibers, ~~given by way of nonlimiting example,~~ which have ~~having~~ undergone a treatment in accordance with ~~according to~~ the present invention. [[,]]

[[-]] Figure ~~figure~~ 5 is an enlarged view of a thread, based on cellulose fibers, which has not ~~having~~ undergone a treatment in accordance with ~~according to~~ the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

For purposes of ~~In order to~~ simplifying the description which follows, which is given ~~and the reading there is described hereafter~~ by way of example, a method and a machine provided in accordance with ~~according to~~ the present invention is described which makes it possible to render a fabric elastic in the weft ~~direction.~~

~~In order~~ direction. The method and the machine of the present invention can similarly be used to obtain elasticity in the warp direction. For this, however, it would be [[is]] necessary to invert ~~inverse~~ the principle of the method and operations [[that]] of the ~~machine.~~

~~Conventionally,~~ machine described hereafter. Also to be noted is that, as is conventional, the rates given below for the squeezing operations to be described are [[the]] "driving off" rates.

Figure 1 shows a preferred embodiment method which is provided in accordance with the present invention, and which is given as a ~~According to the~~ nonlimiting example. In this ~~shown in figure 1, there is firstly applied to a fabric, for~~ example, a fabric (1), such as a hydrophilic fabric and/or a previously bleached fabric, is first impregnated ~~(1) an impregnation~~ (in the Region I) with caustic soda in a bath (2) while [[,]] leaving the fabric free (without weft tension), in this [[such a]] way [[as to]] allowing the weft to swell by impregnation and to become

modified. Other metal peroxides are [[can]] also [[be]] suitable for this, and the treatment can be suitable for [[a]] non-bleached but hydrophilic fabrics such as, for example, a de-sized ~~fabric.~~

~~The~~ fabric. The rate of feed ~~speed of progress~~ of the fabric is regulated in such a way that ~~as to have~~ a predetermined duration of impregnation is provided which is sufficient for a maximum swelling of the weft to occur, while ~~whilst~~ remaining below a threshold of transformation [[,]] and/or of fixing [[,]] and/or of deterioration of the fibers.

After [[its]] exiting from the bath (2) of caustic soda, the fabric undergoes a partial squeezing (in the Region II) in a conventional device used for such purposes, such as a [[of the]] squeezing mangle [[type]] (3). By way of example, a strong squeezing is carried out, with a driving off rate of at least 70%. Other driving off [[;]] ~~other~~ rates are possible, but the squeezing must be strong in order to give [[a]] shape to the cellulose thread.

The ~~Then, the~~ fabric then undergoes [[a]] relaxation (in the Region III). For [[;]] ~~in order for~~ this to happen, the fabric [[it]] is taken into a station (4), for relaxation over a series of rollers. The [[,]] ~~in which the~~ length of travel of the fabric in free air occurs in zig-zag fashion, between the rollers, and is predetermined and sufficient for the weft of the fabric to assume its shape and its shrinkage under the action of the caustic soda.

The fabric then passes ~~After passage (IV)~~ through a tub

(in the Region IV) having [[with]] a direction changing roller (5). The tub can be ~~that is~~ empty, or filled with caustic soda, depending on the characteristics of the fabric (material, weave, weight). Following this, the fabric undergoes a second squeezing (in the Region V) in a squeezing mangle (6), followed by a second relaxation (in the Region VI) without weft tension. This serves to perfect ~~which perfects~~ the shrinkage in the width of the fabric and its "spring effect" which gives the fabric its elasticity ~~of the fabric~~.

The fabric can then optionally undergo ~~possibly undergoes~~ a cold rinsing (in the Region VII) in a tank (8), and [[then]] at least one or two washings (in the Regions VIII and [[,]] IX) in overflowing water tanks (9, 10).

The fabric passes through the [[these]] relaxation stations (4) and (7) without weft tension, but with warp tension, and for a period of time that is sufficient to allow the weft to shrink. This period of time is [[, and]] predetermined according to the characteristics of the fibers and of the fabric.

Following its [[At the]] output, the fabric has acquired a "spring" effect, or elastic effect ~~memory.~~

~~After~~ memory. After a final squeezing (in the Region X) in rollers (11) [[(10)]], the fabric [[it]] is wound (in the Region XI) onto a cylinder (12). The fabric [[and]] can then undergo treatments such as hot washing and/or neutralization of the caustic soda in an acid bath, and normal finishing treatments such as dyeing, drying, stiffening and [[,]] Tumbler drying to

release tensions, etc. It can be important to finish the treatment of the fabric with a passage in a Tumbler machine in order to obtain good elasticity, excellent stability and a good feel. The fabric then assumes a state of equilibrium.

The following is provided as an illustration of the [[The]] characteristics of ~~hereinbelow are given as~~ a preferred but nonlimiting ~~example.~~

~~Treated fabric:~~

[[-]] ~~linen~~ example of a fabric produced in accordance with the above-described method. The fabric had a linen warp, a Tencel® ~~weft,~~

[[-]] ~~square weave,~~

[[-]] ~~fabric~~ weft, and a square weave, and was of rather loose construction to allow ~~allowing~~ the weft to swell sufficiently, for example, by about 30%. Such a [[, this]] construction can be calculated according to a mathematical model.

The fabric was then impregnated in a caustic

~~Impregnation:~~

[[-]] ~~caustic~~ soda bath at 14 to 25° ~~Baumé,~~

[[-]] ~~duration:~~ Baumé for less than 5 minutes, for example, from 3 to 4 ~~minutes~~

~~1st squeezing:~~ minutes. A first squeezing was vigorous, for example, at least ~~70%.~~

~~1st~~ 70%, followed by a first relaxation in ~~air~~

~~2nd squeezing:~~ air. A second squeezing was also vigorous, for

example, at least ~~70%.~~

~~2nd~~ 70%, followed by a second relaxation in ~~air.~~

~~Rinsings~~ air. This was then followed by rinsings and washings [[:]] in water [[:]] (for example, in cold water [[,]] at about 10 m per ~~minute).~~

~~Final squeezing:~~ minute), a final vigorous squeezing ([[,]] for example, at least ~~80%.~~

~~Neutralization~~ 80%), and neutralization of the caustic soda and hot water washing.

Tests on the fabric obtained showed an elasticity on [[of]] the order of 15 to 25%. The fabric obtained exhibited [[with]] good behavior in use because [[since]] it improves with the number of washings in the user's home and is not sensitive to the temperature of the water.

The method of the present invention applies more generally to all fabrics whose weft (or inversely whose warp) is comprised ~~consists~~ of natural cellulose fibers such as, for example, fabrics made of linen or artificial fibers such as, for example, Tencel® or ~~Lyocell®.~~

~~The~~ Lyocell®. The warp (or inversely the weft) can be comprised ~~consist~~ of natural, [[or]] artificial or synthetic fibers.

The present invention also pertains ~~applies~~ to a machine which is specifically ~~specially~~ designed to implement the ~~method.~~

~~This~~ above-described method. Such a machine

principally and successively includes an ~~comprises:~~

[[-]] ~~an impregnation station,~~

[[- at]] impregnation station (2), and at least a first squeezing station ~~(3),~~

[[- at]] (3) and [[least]] a first relaxation station ~~(4),~~

[[-]] ~~possibly~~ (4).

Such a machine can further be optionally and successively provided with the following. A [[a]] tank or bucket (5) can be provided, for use empty or with the addition of peroxide, which can have a [[,]] ~~whose~~ direction-changing roller for ~~is used to~~ preventing folds upon entry to the next station. Filling [[,]] ~~the filling of~~ the bucket (5) makes ~~making~~ it possible to reduce the passage ~~time,~~

[[- a]] time through the tank or bucket (5). A second squeezing station (6) can be provided to ~~which is not obligatory but can~~ improve the effectiveness of the first squeezing station (3), followed by a ~~passage,~~

[[- a]] second relaxation station ~~(7),~~

[[-]] ~~possibly~~ (7). A [[a]] rinsing station (8) can be provided [[,]] ~~knowing that it is also possible~~ to neutralize the fabric in a washer after [[the]] passage through the ~~machine,~~

[[- one]] machine. One ~~washing station (compartment)~~ or two washing stations (or compartments) (9) ~~(10),~~

[[- a]] (10), a final squeezing station ~~(11),~~

[[- a]] (11), and a rolling-up station (12) can also be

provided.

Such a machine can further include ~~It also comprises~~ means for [[of]] regulating the speed of progress and the warp tension in accordance with ~~that is regulated according to~~ the durations necessary for [[the]] impregnation and for [[the]] relaxations of the weft in air. The machine can also include ~~comprises~~ all of the functional controls [[means]] necessary for its operation which are otherwise known to ~~functioning and within the scope of~~ those skilled in the art.

Such a [[The]] machine ~~described above~~ makes it possible to obtain elasticity in the weft direction, that is to say, in the width of the fabric. Throughout the treatment, the warp is tensed, which [[and]] causes the weft ([[,]] which remains free) [[,]] to undulate, and ~~which then~~ becomes fixed in an undulated state. There is a crushing of the weft threads between the warp threads and/or at the warp and weft junction, which remains in memory over the fabric after processing.

The improvements of the present invention, as previously ~~that has just been~~ described, exhibit ~~exhibits~~ the following advantages. In ~~in particular:~~

[[- the]] particular, the method allows the development of a mathematical model which is capable of predicting the characteristics of the fabric after treatment according to the constriction of the fabric, the weave, the mixture, the width, the elasticity, the sought weight, etc. As a result, ~~and therefore to~~

~~define~~ the parameters for [[of]] the treatment can be defined according to a ~~the fabric model~~ previously studied and/or ~~calculated,~~

[[- a]] calculated fabric model.

A large number of natural or artificial cellulose fibers are suitable for use. It is necessary to adapt the concentration of the caustic soda, or of the metal peroxide, to the type of cellulose used. However, [[but]] a natural cellulose fiber such as [[like]] linen or an artificial fiber such as [[like]] Lyocell® (the Tencel® brand, for example) are perfectly adapted to the treatment ~~method,~~

[[- on]] method of the present invention. On Lyocell® fibers, the treatment partially transforms the crystalline nature of the cellulose into amorphous cellulose.

The ~~cellulose,~~

[[- the]] warp and weft stability, upon [[on]] washing of the fabric obtained, is very greatly improved and sanforizing is not necessary after [[the]] dyeing. The shape memory fixes the fabric and a relationship gives rise to a mechanical stability of the ~~fabric,~~

[[- the]] fabric. The feel is ~~improved,~~

[[- the]] improved. The elasticity is not sensitive to the temperature of water, up to 100°C. The [[,]]

[[- the]] fabric fractures less during dyeing, which reduces defects, and the fabric fractures less on

washing, which facilitates ~~thus facilitating~~ ironing. [[,]]

[[- with]] With Lyocell®, there is a great reduction in [[the]] fibrillation during the treatment (dyeing, stiffening), which improves the appearance of the surface of the fabric. The fabric can still be fibrillated, using enzymes. The [[,]] [[- the]] fabric can be modeled and the industrial process is reliable and reproducible, and it [[- it]] is not necessary to heat fix the fabric, as for elasthanne®, which is a great advantage for obtaining well blued whites, which become yellow with heat.

Furthermore, a [[the]] fabric produced in accordance with ~~according to~~ the present invention can be identified, on the one hand, by its straight and tensed warp (or inversely its weft), whereas the weft is undulated and has been locked or fixed in a spring state by a crushing at the junction of the weft fibers and the warp fibers, at the time of the shrinkage. On [[,]] ~~and on~~ the other hand, a fabric produced in accordance with the present invention can be identified by an at least partial transformation [[,]] ~~at least partial,~~ of [[the]] fibers of the crystalline type into amorphous cellulose.

It is also noted that a [[the]] fabric produced in accordance with ~~according to~~ the present invention can be identified by its weft and by its warp, in comparison with a fabric not having undergone such a [[the]] treatment. For

example, [[by]] the ~~following points:~~

[[- the]] weft thread (or inversely the warp thread) of the fabric is less pilous, less round, more flattened, and more crushed. It is in the shape of a fine ribbon, or a fine strip, and has increased brightness under the microscope. The [[,]]

[[- the]] weft (or inversely the warp) assumes a very marked and very visible undulation. Its shape perfectly takes account of the weave of the fabric, and it [[. It]] memorizes a spring state with greater crushing in the space between two warp threads. The [[,]]

[[- the]] weft (or inversely the warp) assumes elasticity according to the construction and a good return force provided ~~as long as~~ the elastic limit is not exceeded. Its ability to withstand torsion is much greater than for a non-treated weft [[.]] ~~This is~~ due to [[the]] shape ~~memory.~~

[[- in]] memory. In the case of an open-end thread, the fagoting of the fibers after treatment reveals, under the microscope, a tendency to create rings around the ~~thread,~~

[[- the]] thread. Moreover, the warp (or inversely the weft) thread is straighter and [[,]] less undulated, with weaker flattening than on a conventional fabric. It is much less flattened than the weft and exhibits

less marked undulation. Its elasticity is weak on cellulose.

Whatever cellulose is used, the treatment of the present invention changes the proportion of the percentages of cellulose I, of cellulose II ([[,]] both crystalline), and of amorphous ~~cellulose.~~

~~The~~ cellulose. The treatment renders the new structure of the cellulose irreversible and makes it possible to obtain good overall mechanical equilibrium.

Figures 2, 3 and 4 show the appearance of a weft (or inversely a warp) thread, of different weaves, treated by the method of ~~according to~~ the present ~~invention.~~

~~They~~ invention. The illustrated threads take advantage of [[the]] shape memory by the flattened structure of the thread, by its crushing at the points of contact, and by the undulations related to the weave. For ~~for example:~~

[[-]] ~~figure~~ example, Figure 2 shows an [[:]] irregular weave. The undulation is marked and the weft ~~twists,~~

[[-]] ~~figure~~ twists. Figure 3 shows a [[:]] regular weave with small loose threads (or ~~passages),~~

[[-]] ~~figure~~ passages). Figure 4 shows a [[:]] regular weave with large loose threads, which [[: It]] takes good advantage of the crushing caused by the warp (or inversely by the ~~weft),~~

[[-]] ~~figure~~ weft). Figure 5 shows a non-elastic thread based on cellulose fibers taken from a fabric not

treated by the [[a]] method of the present invention, and which will assume a characteristic of elasticity after treatment.

A fabric produced in accordance with ~~according to~~ the present invention is, therefore, a fabric that is not naturally elastic. Elasticity [[,]] ~~the elasticity~~ in the weft direction (or inversely, in the warp direction) is conferred upon the fabric [[it]] by chemical and mechanical treatment which modifies the cellulose of the thread constituting the weft (or inversely the warp) in order to give the thread [[it]] a shape memory, the memorized shape being due to the impression of the weave of the fabric during ~~shrinkage.~~

~~After~~ shrinkage. After treatment, the warp (or inversely the weft) is straight and tensed, while ~~whilst~~ the weft is undulated according to a shape or impression depending on the weave of the fabric.

When used in the foregoing description, it is to be understood that the [[The]] expression "not naturally elastic" signifies that the fabric and/or the thread, in the absence of any treatment, does not have any characteristic of elasticity and, in particular, that the fabric [[it]] does not comprise threads which [[that]] are elastic or rendered elastic by manufacture (for example, a wound thread or a thread with an elastic core).